

Appendix

For first order plug flow reactor, the following kinetic equation will hold:

$$\text{WHSV}_{\text{MeOH}} = K C_{\text{MeOH}} M_{\text{MeOH}} / -\ln(1 - X_{\text{MeOH}}) \quad (1)$$

Where,

K = rate constant, function of temperature

C_{MeOH} = MeOH concentration at reactor inlet (mol/ml)

M_{MeOH} = Methanol molecular weight

$\text{WHSV}_{\text{MeOH}}$ = weight hourly space velocity of methanol

X_{MeOH} = conversion of methanol

It is noted from equation (1) when temperature is not changed, $K C_{\text{MeOH}} M_{\text{MeOH}}$ remains constant. MeOH conversion X_{MeOH} should decrease with increase in $\text{WHSV}_{\text{MeOH}}$. Using this kinetic equation, by entering $\text{WHSV}_{\text{MeOH}}$ at 99.9% (13.4), we obtained $\text{WHSV}_{\text{MeOH}}$ at 57% conversion = 109.7 h^{-1} , which is equivalent to $\text{LHSV} = 249.6 \text{ h}^{-1}$ ($S/C = 1.78$)

S/C =	1.78	w/w =	1.00125
LHSV =	30.5	Density =	0.88
Total WHSV =	26.84	g/cc.h	
WHSV MeOH =	13.41162	g/cc.h	
WHSV H ₂ O	13.42838	g/cc.h	

Conversion at LHSV = 30.5 h^{-1}	0.999
Conversion at 57%	0.57
Calculated WHSV MeOH at 57%	109.7719 g/cc.h
WHSV H ₂ O at 57%	109.9091 g/cc.h
Total LHSV	249.6374 h^{-1}